

## Nige Cook

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**Sent:** 02 February 2011 08:56  
**Subject:** Re: faster than light?

The EPR attack on first quantization is right. There is no wavefunction in nature.

Nobody has ever seen a wavefunction, or measured a wavefunction.

Schroedinger guessed that a wavefunction exists and  $H\Psi = i\hbar d\Psi/dt$ .

Dirac pointed out this has the solution  $(\Psi_t)/(\Psi_0) = \exp(-iHt/\hbar)$ .

Feynman showed that  $-Ht = S$ , so the "wavefunction" varies with time  $t$  in direct proportion to the factor  $\exp(iS)$ , with  $S$  expressed in terms of action unit  $\hbar$ .

Instead of the wavefunction "collapsing when measured", it is determined by multipath interference. Virtual quanta go along all "cancelled paths"; the real photon is defined to be that whose path is uncanceled by interference.

Feynman starts in 1948-65 with a complex wheel (i.e. rotating a unit length arrow around an Argand diagram) that violates Haag's theorem because in complex space the infinite number of paths require Hilbert space, which prevents vacuum renormalization from being done unambiguously.

In his 1985 book QED he reinvents his circular wheel from the Argand diagram to regular Euclidean space (no complex plane),  $\exp(iS) \rightarrow \cos S$  (via Euler).

The resultant arrow for  $\exp(iS)$  is a vector (with both direction and length).

However, you don't need the direction: by definition the path integral is relativistic, which as Dirac explains (see my blog) is required for least action.

In other words, the direction of the arrow expressing the path integral is

not  
 required: it's the relativistic (on-shell) path, so we can take that  
 direction as  
 the x-axis, so  $\cos S$  then accurately represents the magnitudes you need to  
 add together to get the path integral magnitude, replacing  $\exp(iS)$ .

This is because the path of least action is defined as the path whose action  
 $S$   
 is unaffected by small variations in the coordinates, making that path  
 relativistic.

So the 1st quantization wavefunction collapse is completely wrong. It's not  
 the observer that determines probability of finding a particle here or  
 there:  
 instead, it's the interference of the multiple paths taken, most of which  
 cancel.

When a photon arrives on a screen, it is not the observer that determines if  
 it is here or there: it is the interference between multiple paths taken by  
 the  
 photon. I don't want to be rude, Brian, but why oh why is Feynman still not  
 taken seriously? Why is the simple sum over histories approach ignored?

Feynman makes the point that 1st quantization is wrong, so the wavefunction  
 doesn't collapse upon measurement and the EPR paradox's resolution is 2nd  
 quantization, i.e. the polarized photons travel not with indeterminate  
 wavefunctions that collapse when measured, but rather with a path integral  
 where a range of paths are taken by mainly virtual (off-shell) photons in  
 the present universe, and these only tend to reinforce for small (but  
 non-zero actions (QED, 1985). Feynman's point about the path integration for  
 light polarization in QED (1985) is that each virtual photon travels with  
 the same rotating phase vector (rotating with the frequency of the light),  
 and the sum of all the path phase vector's (like arrows) determines the  
 resultant. Obviously the path taken is not the path of least action, because  
 if it were the path of least action, then light would be entirely classical  
 and would fail to explain the double slit experiment. Instead, in Feynman's  
 words, it takes a spread of paths with actions small compared to  $\hbar$ , not  
 not merely zero. This spread of paths explains the double slit experiment,  
 because "small core of space" taken by light with action not zero but less  
 than  $\hbar$  is large enough to allow some paths to travel through each of the  
 two-slits and to recombine on reaching the screen, with the observed  
 interference pattern.

Applying this path integral to the EPR, you get rid of observer induced (or  
 measurement induced) wavefunction collapse. There is no wavefunction  
 collapse due to measurement if path integrals are right. The whole of the  
 EPR paradox is 1st quantization, which Dirac and Feynman disproved as  
 non-relativistic. Bohr and Heisenberg, together with Pauli and others, went  
 on believing 1st quantization, even shouting Feynman down at Pocono in 1948,  
 believing that he didn't "understand" the uncertainty principle. They  
 wouldn't buy the path integral, they thought there were no paths because we  
 are not morally permitted by God to mathematically do a path integral. They  
 thought we have to treat it statistically as an intrinsically indeterminate

wavefunction that collapses upon measurement, not as a path integral where the indeterminacy arises from the complexity of the many virtual paths taken, and the effects of chaotic field quanta.

The "cancelled paths" taken by a "photon" are normal exchange radiation paths (all charges such as electrons are continually exchanging virtual photons). An on-shell or "real" photon is an asymmetry in the exchange of this virtual radiation.

'light doesn't really travel only in a straight line; it "smells" the neighboring paths around it, and uses a small core of nearby space. (In the same way, a mirror has to have enough size to reflect normally: if the mirror is too small for the core of neighboring paths, the light scatters in many directions, no matter where you put the mirror.)'

- Richard P. Feynman, QED, Penguin Books, London, 1990, Chapter 2, p. 54.

"The quantum collapse [in the mainstream interpretation of first quantization quantum mechanics, where a wavefunction collapse occurs whenever a measurement of a particle is made] occurs when we model the wave moving according to Schroedinger (time-dependent) and then, suddenly at the time of interaction we require it to be in an eigenstate and hence to also be a solution of Schroedinger (time-independent). The collapse of the wave function is due to a discontinuity in the equations used to model the physics, it is not inherent in the physics." - Thomas Love, California State University.

"In some key Bell experiments, including two of the well-known ones by Alain Aspect, 1981-2, it is only after the subtraction of 'accidentals' from the coincidence counts that we get violations of Bell tests. The data adjustment, producing increases of up to 60% in the test statistics, has never been adequately justified. Few published experiments give sufficient information for the reader to make a fair assessment." - [http://arxiv.org/PS\\_cache/quant-ph/pdf/9903/9903066v2.pdf](http://arxiv.org/PS_cache/quant-ph/pdf/9903/9903066v2.pdf)

First quantization for QM (e.g. Schroedinger) quantizes the product of position and momentum of an electron, rather than the Coulomb field which is treated classically. This leads to a mathematically useful approximation for bound states like atoms, which is physically false and inaccurate in detail (a bit like Ptolemy's epicycles, where all planets were assumed to orbit Earth in circles within circles). Feynman explains this in his 1985 book QED (he dismisses the uncertainty principle as complete model, in favour of path integrals) because indeterminacy is physically caused by virtual particle interactions from the quantized Coulomb field becoming important on small, subatomic scales! Second quantization (QFT) introduced by Dirac in 1929 and developed with Feynman's path integrals in 1948, instead quantizes the field. Second quantization is physically the correct theory because all indeterminacy results from the random fluctuations in the interactions of discrete field quanta, and first quantization by Heisenberg and Schroedinger's approaches is just a semi-classical, non-relativistic mathematical approximation useful for obtaining simple mathematical solutions for bound states like atoms:

'You might wonder how such simple actions could produce such a complex world. It's because phenomena we see in the world are the result of an enormous intertwining of tremendous numbers of photon exchanges and interferences.'

- Richard P. Feynman, QED, Penguin Books, London, 1990, p. 114.

'Underneath so many of the phenomena we see every day are only three basic actions: one is described by the simple coupling number,  $j$ ; the other two by functions  $P(A \text{ to } B)$  and  $E(A \text{ to } B)$  - both of which are closely related. That's all there is to it, and from it all the rest of the laws of physics come.'

- Richard P. Feynman, QED, Penguin Books, London, 1990, p. 120.

'It always bothers me that, according to the laws as we understand them today, it takes a computing machine an infinite number of logical operations to figure out what goes on in no matter how tiny a region of space, and no matter how tiny a region of time. How can all that be going on in that tiny space? Why should it take an infinite amount of logic to figure out what one tiny piece of spacetime is going to do? So I have often made the hypothesis that ultimately physics will not require a mathematical statement, that in the end the machinery will be revealed, and the laws will turn out to be simple, like the chequer board with all its apparent complexities.'

- R. P. Feynman, The Character of Physical Law, November 1964 Cornell Lectures, broadcast and published in 1965 by BBC, pp. 57-8.

Sound waves are composed of the group oscillations of large numbers of randomly colliding air molecules; despite the randomness of individual air molecule collisions, the average pressure variations from many molecules obey a simple wave equation and carry the wave energy. Likewise, although the actual motion of an atomic electron is random due to individual interactions with field quanta, the average location of the electron resulting from many random field quanta interactions is non-random and can be described by a simple wave equation such as Schroedinger's.

This is fact, it isn't my opinion or speculation: professor David Bohm in 1952 proved that "brownian motion" of an atomic electron will result in average positions described by a Schroedinger wave equation. Unfortunately, Bohm also introduced unnecessary "hidden variables" with an infinite field potential into his messy treatment, making it a needlessly complex, uncheckable representation, instead of simply accepting that the quantum field interactions produce the "Brownian motion" of the electron as described by Feynman's path integrals for simple random field quanta interactions with the electron.

Quantum tunnelling is possible because electromagnetic fields are not classical, but are mediated by field quanta randomly exchanged between charges. For large charges and/or long times, the number of field quanta exchanged is so large that the result is similar to a steady classical field. But for small charges and small times, such as the scattering of charges in high energy physics, there is some small probability that no or few field quanta will happen to be exchanged in the time available, so the

charge will be able to penetrate through the classical "Coulomb barrier". If you quantize the Coulomb field, the electron's motion is indeterministic in the atom because it's randomly exchanging Coulomb field quanta which cause chaotic motion. This is second quantization as explained by Feynman in QED. This is not what is done in quantum mechanics, which is based on first quantization, i.e. treating the Coulomb field  $V$  classically, and falsely representing the chaotic motion of the electron by a wave-type equation. This is a physically false mathematical model since it omits the physical cause of the indeterminacy (although it gives convenient predictions, somewhat like Ptolemy's accurate epicycle based predictions of planetary positions).

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 Sent: Tuesday, February 01, 2011 8:45 PM  
 Subject: faster than light?

> Since there have been suggestions that optical fibres/waveguides can  
 > transmit signals faster than light, I'd like to post this expert (and  
 > generally accepted) view on the matter:  
 >  
 > <[http://en.wikipedia.org/wiki/Faster-than-light#Group\\_velocities\\_above\\_c](http://en.wikipedia.org/wiki/Faster-than-light#Group_velocities_above_c)>  
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 >  
 > The group velocity of a wave (e.g. a light beam) may ... exceed  $c$  in some  
 > circumstances. In such cases, which typically at the same time involve  
 > rapid attenuation of the intensity, the maximum of the envelope of a pulse  
 > may travel with a velocity above  $c$ . However, even this situation does not  
 > imply the propagation of signals with a velocity above  $c$ , [41] even though  
 > one may be tempted to associate pulse maxima with signals. The latter  
 > association has been shown to be misleading, basically because the

> information on the arrival of a pulse can be obtained before the pulse  
> maximum arrives. For example, if some mechanism allows the full  
> transmission of the leading part of a pulse while strongly attenuating the  
> pulse maximum and everything behind (distortion), the pulse maximum is  
> effectively shifted forward in time, while the information on the pulse  
> does not come faster than  $c$  without this effect.

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>  
> and a further clarification:  
>  
> <[http://en.wikipedia.org/wiki/G%C3%BCnter\\_Nimtz#Experiments\\_related\\_to\\_superluminal\\_quantum\\_tunneling](http://en.wikipedia.org/wiki/G%C3%BCnter_Nimtz#Experiments_related_to_superluminal_quantum_tunneling)>  
>  
> Aephraim M. Steinberg of the University of Toronto has ... stated that  
> Nimtz has not demonstrated causality violation (which would be implied by  
> transmitting information faster than light). Steinberg also uses a  
> classical argument.[3] In a New Scientist article, he uses the analogy of  
> a train traveling from Chicago to New York, but dropping off train cars at  
> each station along the way, so that the center of the train moves forward  
> at each stop; in this way, the speed of the center of the train exceeds  
> the speed of any of the individual cars.[11]

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